Dart Aerospace Ltd.

Date: Friday, 17/10/2008 12:42:27 PM
User: Julie Dawson

Process Sheet

Customer	: CU-DAR001 Dart Helicopters Services	**Drawing Name**	: LUG
Job Number	: 42714		
Estimate Number	: 11683		
P.O. Number	:	**Part Number**	: D2888
This Issue	: 17/10/2008 **S.O. No.** :	**Drawing Number**	: D2888 REV A2
Prsht Rev.	: NC	**Project Number**	: N/A
First Issue	: / / **Type** : MACHINED PARTS	**Drawing Revision**	: A
Previous Run	: 40733	**Material**	:
Written By	:	**Due Date**	: 05/11/2008 **Qty:** ~~11~~ 15 **Um:** Each
Checked & Approved By	: JD 08.10.17		
Comment	: Est. C 00.06.22 Removed P/O for powder coat EC		

Additional Product

Job Number:

Seq. #:	Machine Or Operation:	Description :
1.0	M6061T6B2500X03500	6061-T6 Bar 2.50 x 3.50

Comment: Qty.: 0.3938 f(s)/Unit Total : 4.3313 f(s)
6061-T6 Bar 2.5" x 3.5"
Material: 3.5" x 2.5" bar 6061-T6 Batch M102838 H.A 08/10/22

2.0	BAND SAW	BAND SAW

Comment: BAND SAW
Cut blanks 4.20" long
(Grain along 4.20") H.A 08/10/22

3.0	HAAS1	HAAS CNC VERTICAL MACHINING #1

Comment: HAAS CNC VERTICAL MACHINING #1
Machine as per folio D2888
Deburr and Tumble RD 08/10/24

4.0	QC2	INSPECT PARTS AS THEY COME OFF MACHINE

Comment: INSPECT PARTS AS THEY COME OFF MACHINE RD 08/10/24 (15)

5.0	QC8	SECOND CHECK

Comment: SECOND CHECK SA 08/10/24 (15)

Form: rprocess

Dart Aerospace Ltd

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: _____ **PAR #:** _____ **Fault Category:** _____ **NCR:** Yes No **DQA:** _____ **Date:** _____

Resolution: _____ **Disposition:** _____ **QA: N/C Closed:** _____ **Date:** _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			

NOTE: Date & initial all entries

Date: Friday, 17/10/2008 12:42:27 PM
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Job Number: 42714 **Part Number:** D2888

Job Number:

Seq. #:	Machine Or Operation:	Description :
6.0	HAND FINISHING1	HAND FINISHING RESOURCE #1

1.5x

Comment: HAND FINISHING RESOURCE #1
Acid etch and Alodine as per QSI 005 4.1

M-L 08/10/27

7.0	POWDER COATING	POWDER COATING

M 109/52

Comment: POWDER COATING
Powder Coat White Gloss (Ref: 4.3.5.1) as per QSI 005 4.3

15

START TIME: 7:45
OVEN TEMPERATURE: 320°
FINISH TIME: 8:15

FL 08/10/28

8.0	QC3	INSPECT POWDER COAT/CHEMICAL CONVERSION

Comment: INSPECT POWDER COAT/CHEMICAL CONVERSION 08-10-28 X 15

9.0	PACKAGING 1	PACKAGING RESOURCE #1

1.5x

Comment: PACKAGING RESOURCE #1
Identify and Stock
Location: 470

8/10/28

10.0	QC21	FINAL INSPECTION/W/O RELEASE

15

Comment: FINAL INSPECTION/W/O RELEASE

08/10/29

Job Completion

08.10.29

Form: rprocess

Dart Aerospace Ltd

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: _____ **PAR #:** _____ **Fault Category:** _____ **NCR:** Yes No **DQA:** _____ **Date:** _____

Resolution: _____ **Disposition:** _____ **QA: N/C Closed:** _____ **Date:** _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B: Initial Chief Eng	Action Description Chief Eng	Sign & Date	Verification Section C	Approval Chief Eng	Approval QC Inspector
08/10/24	# 3.0	.760 hole location ~~off~~ by ~~.005~~ t.004 OK (x3) RC. orig. was off.	QP 08.10.24 pc Q51042	Acceptable	RH 08/10/24		QP 08.10.24 pc Q51042	08/10/24
08/10/24	# 3.0	two parts have dim. 0.375" at 0.360". Q4y (2) RC too much offset to fix First ~~problem~~ problem	QP 08.10.24 pc Q51042	Acceptable. Margins of safety still positive. See attached SR	MA 08/10/24		QP 08.10.24 pc Q51042	08/10/24

NOTE: Date & initial all entries

DART AEROSPACE LTD	Work Order:	42714
Description: Lug	Part Number:	D2888
Inspection Dwg: D2888 Rev: A2		Page 1 of 1

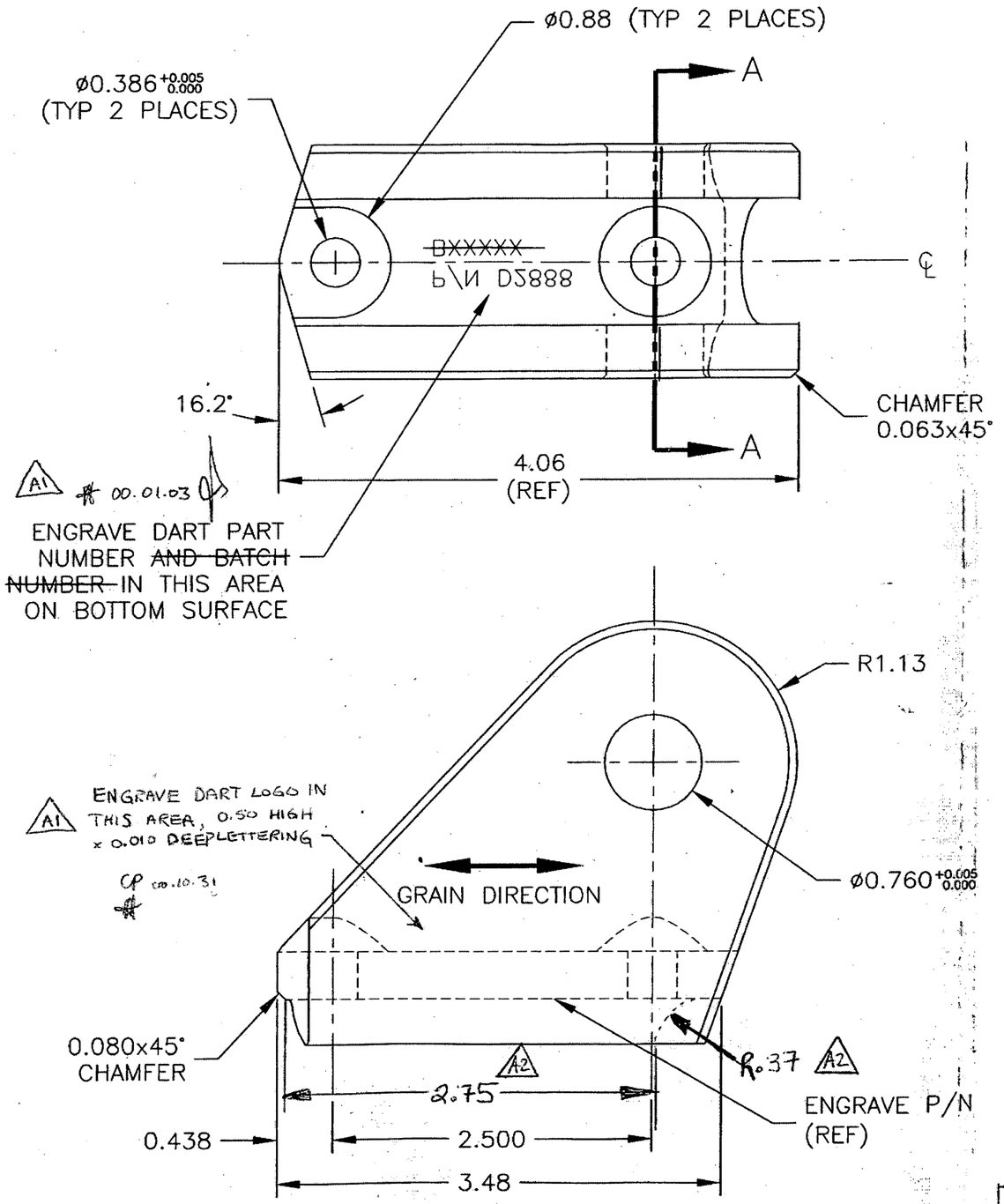
FIRST ARTICLE INSPECTION CHECKLIST

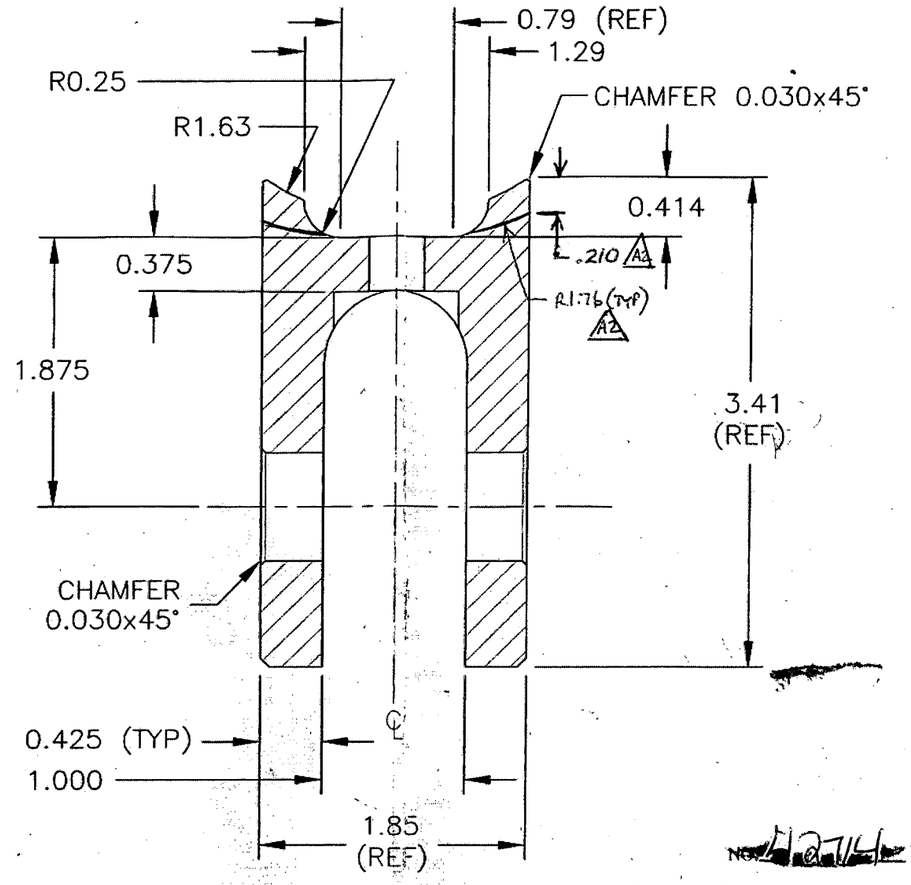
[X] First Article [ ] Prototype

Drawing Dimension	Tolerance	Actual Dimension	Accept	Reject	Method of Inspection	Comments
Ø0.386	+0.005/-0.000	.387				
Ø0.88	+/-0.030	.825				
0.063 x 45°	+/-0.010	.063 x 45°				
4.06	+/-0.030	4.04				
Ø0.760	+0.005/-0.000	.761				
3.48	+/-0.030	3.475				
2.500	+/-0.010	2.500				
2.75	+/-0.030	2.75				
0.438	+/-0.010	.438				
0.080 x 45°	+/-0.010	.080 x 45°				
1.85	+/-0.030	1.85				
1.000	+/-0.010	1.005				
0.425	+/-0.010	.425				
0.030 x 45°	+/-0.010	.03 x 45°				
1.875	+/-0.010	1.878				
0.375	+/-0.010	.372				
R0.25	+/-0.030	R.25				
1.29	+/-0.030	1.29				
0.414	+/-0.010	.414				
3.41	+/-0.030	3.41				

Measured by:		Audited by:		Prototype Approval:	N/A
Date:	08/10/24	Date:	08/10/24	Date:	N/A

Rev	Date	Change	Revised by	Approved
A	08.06.04	New Issue	KJ/DD	





SECTION A–A
SCALE 1:1

NCR 754

RELEASED
99.07.09 DS

MATERIAL: 6061–T6 (QQ–A–200/8 OR QQ–A–250/11 OR QQ–A–225/8)
FINISH: ACID ETCH AND ALODINE PER DART QSI 005 4.1
POWDER COAT WHITE (4.3.5.1) PER DART QSI 005 4.3
BREAK UNMARKED EDGES 0.010 TO 0.020
TOLERANCES ARE PER DART QSI 018 UNLESS OTHERWISE NOTED

A2	04.04.08	Add Saddle Clearance Per NCR 754	
A1	00.10.31	Update Engraving	CP 00.10.31 #

A		99.06.21	NEW ISSUE
DESIGN #	DRAWN BY CP	DART	DART AEROSPACE LTD HAWKESBURY, ONTARIO, CANADA
CHECKED #	APPROVED RE	DRAWING NO. D2888	REV. A SHEET 1 OF 1
DATE 99.06.21		TITLE LUG	SCALE 1:1

3.0 Geometry and Loads

3.1 Geometry

The lug mounts to the inboard aft saddle (and thus the crosstubes) which are set at a 50 degree angle (value "theta"). A force F is applied to the lug at the 0.750" diameter hole (pin location). Misalignment of the saddles would result in an eccentric loading of the lug. A one degree maximum angle of misalignment (value "ecc", this corresponds to approximately 2 inches of misalignment) will be assumed. The reaction force of the saddle due to the eccentric force occurs at 28.5 degrees (value "gamma") wrt the X-Y plane (per figure 1), with a moment arm "d3" wrt the bolts. These values are shown in figure 1.

SF := 1.5	Safety Factor
FF := 1.15	Fitting Factor
ecc := 1·deg	Eccentricity of applied force
theta := 50·deg	Angle of F wrt Y-Z plane
gamma := 28.5·deg	Direction of Saddle Reaction Force
d1 := 2.500·in	Distance between Bolt centers
d2 := 1.500·in	Distance between Pin and Bolt centers
d3 := 1.014·in	Moment Arm of Saddle Reaction wrt Bolts
L := 3.10·in	Length of lug contacting saddles
w := 0.291·in	Width of Lug area contacting saddle
Dcp := 0.750·in	Lug pin hole diameter
tcp := 0.437·in	Lug thickness at pin hole
ecp := 0.750·in	Lug edge distance at pin hole
Dcb := 0.375·in	Bolt hole diameter
→ tcb := 0.360·in WAS 0.375	Lug base thickness
ecb := 0.250·in	Lug edge distance at bolt holes

FIGURE 1: Geometry

5.4 Bending Failure of the Lug at section A-A (refer to Figure 1)

$L = 3.100 \cdot in$ Length of Lug contacting saddle

$tcp = 0 \cdot in$ Lug thickness at Pin arm

$I := \frac{1}{12} \cdot L \cdot tcp^3$ $I = 0 \cdot in^4$ Moment of Inertia of Lug section

$d2 = 2 \cdot in$ Moment arm about section

$M := F \cdot \sin(ecc) \cdot d2$ Moment about section

$fb := \frac{M \cdot tcp}{2 \cdot I}$ $fb = 1373 \cdot psi$ Bending Stress in section

$MS4a := \frac{Fcy}{fb} - 1$ $MS4a = 20.85$ **Margin of Safety (Limit)**

$MS4b := \frac{Fcu}{SF \cdot fb} - 1$ $MS4b = 16.17$ **Margin of Safety (Ultimate)**

5.5 Bearing Failure of the Lug at the Bolt Holes

$Dcb = 0 \cdot in$ Bolt hole diameter

$tcb = 0 \cdot in$ Lug base thickness

$Fbsmax = 1667.4 \cdot lbf$ Force per Bolt Hole

$Abb := Dcb \cdot tcb$ $Abb = 0 \cdot in^2$ Bearing Area (at bolt)

$fbyb := \frac{Fbsmax}{Abb}$ $fbyb = 12351 \cdot psi$ Bearing Stress (at bolt)

$MS5a := \frac{Fbry2}{fbyb} - 1$ $MS5a = 1.28$ **Margin of Safety (Limit)**

$MS5b := \frac{Fbru2}{SF \cdot fbyb} - 1$ $MS5b = 0.88$ **Margin of Safety (Ultimate)**

5.6 Shear Failure of the Lug at the Bolt Holes

$ecb = 0 \cdot in$ Lug edge distance at bolt holes

$tcb = 0 \cdot in$ Lug thickness at bolt holes

$Asb := 2 \cdot ecb \cdot tcb$ $Asb = 0 \cdot in^2$ Shear Area (at bolt)

$fsyb := \frac{Fbsmax}{Asb}$ $fsyb = 9264 \cdot psi$ Shear Stress (at bolt)

$MS6a := \frac{Fsy}{fsyb} - 1$ $MS6a = 0.74$ **Margin of Safety (Limit)**

$MS6b := \frac{Fsu}{SF \cdot fsyb} - 1$ $MS6b = 0.37$ **Margin of Safety (Ultimate)**

5.7 Tensile Failure of the Lug at the Bolt Holes

$ecb = 0 \cdot in$ Lug edge distance at pin hole
$tcb = 0 \cdot in$ Lug thickness at pin hole

$Atb := 2 \cdot ecb \cdot tcb$ $Atb = 0 \cdot in^2$ Tensile Area (at pin)

$ftyb := \frac{Fbsmax}{Atb}$ $ftyb = 9264 \cdot psi$ Tensile Stress (at pin)

$MS7a := \frac{Fty}{ftyb} - 1$ $MS7a = 2.02$ **Margin of Safety (Limit)**

$MS7b := \frac{Ftu}{SF \cdot ftyb} - 1$ $MS7b = 1.37$ **Margin of Safety (Ultimate)**

5.8 Tensile Failure of the Bolts

$MS8a := \frac{Ftyb}{Fbtmax} - 1$ $MS8a = 2.77$ **Margin of Safety (Limit)**

$MS8b := \frac{Ftub}{SF \cdot Fbtmax} - 1$ $MS8b = 2.28$ **Margin of Safety (Ultimate)**

5.9 Shear Failure of the Bolts

$MS9b := \frac{Fsb}{SF \cdot Fbtmax} - 1$ $MS9b = 1.69$ **Margin of Safety (Ultimate)**

5.10 Compressive Failure of the Lug

The reaction force (Fsad), which is due to the eccentricity of the applied force, causes compression of both the lug's outer flange and the area contacting the saddle (see figures 1 & 2).

$w = 0 \cdot in$ Width of Lug area contacting saddle
$L = 3 \cdot in$ Length of Lug area contacting saddle

$Alug := w \cdot L$ $Alug = 1 \cdot in^2$ Area of Lug contacting saddle

$fcy := \frac{Fsad}{Alug}$ $fcy = 148 \cdot psi$ Compressive Stress on area

$MS10a := \frac{Fcy}{fcy} - 1$ $MS10a = 201.56$ **Margin of Safety (Yield)**

$MS10b := \frac{Fcu}{SF \cdot fcy} - 1$ $MS10b = 158.16$ **Margin of Safety (Ultimate)**